

TITLE OF THE INVENTION

WIRELESS COMMUNICATIONS METHODS AND SYSTEMS USING
A REMOTE, SELF-CONTAINED COMMUNICATIONS ANTENNA UNIT

~~PRIORITY APPLICATION~~

5 This application claims priority to co-pending US Provisional Application No. 60/169,982 filed August 25, 2000, entitled "Wireless Communications Methods and Systems Using Remote, Self-Contained Communications Devices," which is fully incorporated herein by reference.

CROSS REFERENCE TO RELATED APPLICATIONS

- 10 This application relates to applicant's co-pending Attorney Docket Number 36968-206524 application filed simultaneously herewith, entitled "Wireless Communications Methods And Systems Using A Remote, Self-Contained Cell Site" which is fully incorporated herein by reference.

COPYRIGHT NOTIFICATION

- 15 A portion of the disclosure of this patent document and its figures contain material that is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent files or records, but otherwise reserves all copyrights whatsoever.

20 BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the field of wireless communications. More particularly, this invention relates to wireless communications methods and systems for wireless personal communication devices and for interconnecting these wireless personal

communication devices over a linking frequency using a remote, self-contained communications antenna unit.

2. Background

Wireless communication networks comprise one or more cell sites that assign
5 radio channels for connecting a wireless personal communication device, such as, for
example, a cellular telephone, to another telephone (wireless or wired) through a cellular
switch connected to a terrestrial telephone network. Wireless communication networks
typically include a plurality of interconnected (wireless or wired) cell sites that are
coupled with a centrally located cellular switch, called a Mobile Telephone Switching
10 Office (MTSO), and that connect to a communications network. Cell sites are essentially
buildings that house equipment for transmitting, receiving, and processing wireless
communications to the communications network. There are typically fifty to one hundred
cell sites in large cities, fifteen to fifty cell sites in smaller cities, and very few cell sites or
none in rural areas. Depending on capacity constraints, cell sites may be located one-half
15 to twenty miles from each other. Further, each cell site generally comprises one or more
stationary antennas mounted on a triangular platform that is placed on a tower or atop a
tall building preferably sixty to three hundred feet above the surrounding terrain.

Conventional installation of a new cell site requires placement of one or more
antennas and construction of a cable transmission path for a wired connection (e.g., use of
20 a T1) of the cell site to a switching system. The cost associated with installing a new cell
site is very substantial and ranges on the average from several hundred thousand to half a
million dollars. Additionally, actual siting may not be available for a variety of reasons,
such as unavailability of the sector for the physical plant that contains the cell site, terrain
restraints, regulatory restraints, and the like.

25 When the wired connection is lost to a conventional cell site, the cell site is
disconnected and goes "off the air." Wireless personal communication devices serviced
by the disconnected cell site cannot transmit or receive signals (i.e., a customer cannot
place or receive a telephone call). Depending on the nature of the trouble, the cell site
could be off the air for an extended period of time. Loss of revenue to the cellular

provider and customer inconvenience result until the wired connection is repaired and restored. While there are techniques known in the art that provide emergency means in case of a line fault, they: (1) are bulky and difficult to readily implement; (2) are expensive; and (3) have a limit in the number of applicable connections and in the applicable status of a connection.

Thus, replacement methods and systems are needed to provide easy, affordable, and flexible remote wireless communications with wireless personal communication devices communicating with a disconnected cell site and to connect these devices with a communications network.

SUMMARY OF THE INVENTION

This invention provides wireless communications using a remote, self-contained communications antenna unit coupled to a disconnected cell site to communicate with a cellular system connected to a communications network. As used herein, a "disconnected" cell site includes remote cell sites, such as, for example, a cell on wheels (COW) and also includes conventional cell sites (i.e., buildings with cellular transceiving equipment) that have lost connection with a cellular switch (e.g., the T1 is cut or there is another line fault) and are "off the air." As used herein, the term "transceive" includes transmitting, receiving, and processing communication signals. Further, as used herein, a "communications network" includes terrestrial communications networks, such as, for example, the public switch telephone network, as well as celestial communications networks. When the remote, self-contained communications antenna unit is coupled (e.g., wired or wireless connection) to a disconnected cell site, it has the appearance of a operational cell site to the communications network. This invention provides a rapid, inexpensive, and efficient method and system to transceive wireless communication signals (e.g., the Industrial, Scientific, and Medical (ISM) Band frequencies, such as, 2.4-2.5GHz, cellular telephone frequencies, such as, 806-960 MHz, 1710-1855 MHz, and 2500-2690 MHz, paging frequencies, digital processing frequencies, and any other frequency in the electromagnetic spectrum) from wireless personal communication devices communicating with a disconnected cell site and to connect these wireless

personal communication devices with the communications network. Further, this invention is easily positioned at a variety of locations because of the highly mobile platforms that carry the remote, self-contained communications antenna unit.

The remote, self-contained communications antenna unit is coupled with a
5 disconnected cell site to provide remote communications with wireless personal devices. The wireless personal devices transceive radio frequencies to the disconnected cell site, and these signals are communicated to the remote, self-contained communications antenna unit. The remote, self-contained communications unit transceives these signals to the communications network. In one embodiment, the remote, self-contained
10 communications antenna unit may be hard-wired using a T-1 connection to a local service provider's crossbox junction point that connects to a cellular switch, such as, for example, a MTSO. In a second embodiment, the remote, self-contained communications antenna unit transceives these signals using a microwave frequency link to an operational cell site. The operational cell site connects these signals to the MTSO and the communications
15 network. In a third embodiment, the remote, self-contained communications antenna unit transceives these signals to a second remote, self-contained communications antenna unit that is connected to an operational cell site. The second remote, self-contained communications antenna unit may be used as an alternative to a direct connection with an operational cell site when there are obstacles (e.g., terrain obstruction) between the
20 remote, self-contained communications antenna unit coupled with the disconnected cell site and the operational cell site.

The remote, self-contained communications antenna unit includes a power source, backup power source, transceiving equipment, a signal processor, network communications equipment, antenna, and an antenna mast for transmitting and receiving
25 wireless communications at various heights. Further, the remote, self-contained communications antenna unit may be mounted upon a transportation vehicle.

In a preferred embodiment, the remote, self-contained communications antenna unit is a trailer that transports and carries a generator for power, backup batteries, transceiving equipment, a digital signal processor (DSX), a network interface unit (NIU),
30 an air conditioner, an antenna, and an extendible mast that supports the antenna. The

remote, self-contained communications antenna unit also includes a power charging unit, such as a battery charger.

This invention is useful for restoring cell site functionality, for providing emergency service, for increasing cellular capacity, and for adding a remote, self-contained communications antenna unit coupled with a disconnected cell site. For instance, this invention provides cellular service where a line fault has disconnected the conventional cell site and caused it to go "off the air" (e.g., the T1 connection to the terrestrial telephone network has been cut). It provides service to a location out of range of cell sites, such as service to a rural location. This invention is also useful for temporarily increasing cellular capacity, such as, for example, providing cellular coverage to customers attending large events like the SuperBowl and the Olympics. Further, this invention is useful for adding a permanent cell site when laying a transmission path to a switching system is difficult or impossible or when adding a permanent cell site is too costly.

These uses may be accomplished singularly, or in combination, in one or more of the embodiments of the this invention.

Additional uses, objects, advantages, and novel features of the invention are set forth in the detailed description that follows and will become more apparent to those skilled in the art upon examination of the following or by practice of the invention.

BRIEF DESCRIPTION OF THE FIGURES

Other uses, objects, advantages, and novel features of this invention are more clearly understood by reference to the following and the accompanying figures, in which:

Figure 1 illustrates the communications paths using a first remote, self-contained communication antenna unit of this invention coupled with a disconnected cell site to communicate signals to a second remote, self-contained communications antenna unit of this invention coupled with an operational cell site.

Figure 2 is a more detailed schematic diagram of the remote, self-contained communications antenna unit of this invention shown in Figure 1.

DETAILED DESCRIPTION

The following is presented by way of example and should not be construed as limiting the inventive concept to any particular configuration.

In conventional wireless communications networks, a plurality of interconnected
5 switching systems are coupled with a plurality of cell sites that transmit and receive signals to wireless personal communication devices. This invention allows wireless communication service providers to rapidly, inexpensively, and efficiently provide wireless communication coverage to restore functionality to a disconnected cell site.

Figure 1 depicts the communications paths using remote, self-contained
10 communications antenna unit 116 coupled with disconnected cell site 119 and using another remote, self-contained communication antenna unit 109 connected to the communications network through cell site 101. Cell site 101 is said to be "on the air" when it is connected to a switching system of the communications network, such as the MTSO, over a wired medium 100. Disconnected cell site 119 is said to be "off the air" or
15 "disconnected" when it is not connected to a switching system of the communications network, such as when a conventional cell site's T1 cable to the MTSO is cut 127.

Cell site 101 connects wireless personal devices 106, 107 with the communications network. Cell site 101 is coupled to an antenna 103 using a wired medium 102. Cell site 101 is capable of transceiving signals 104, 105 with a plurality of
20 wireless personal communication devices 106, 107 and is capable of communicating signals 104, 105 over the communications network. Cell site 101 is connected to a remote, self-contained communications antenna unit 109 using a wired medium 108, such as a T1 cable. Alternatively, wireless communications could be used to establish a connection between cell site 101 and remote, self-contained communications antenna unit
25 109.

Remote, self-contained communications antenna unit 109 includes a mast 110 that supports a microwave antenna 111. Microwave antenna 111 transceives signals with microwave antenna 112 of remote, self-contained communications antenna unit 116 on a linking frequency signal 113. Mast 114 supports microwave antenna 112 and radio
30 frequency antenna 115. Remote, self-contained communications antenna unit 116 may

use a wired medium **118**, such as a T1 cable, to connect Network Interface Unit (NIU) **117** to Customer Service Unit (CSU) **120**. Alternatively, remote, self-contained communications antenna unit **116** may use wireless communications to communicate with disconnected cell site **119**. For example, radio frequency antenna **115** may transceive signals with radio frequency antenna **128**. Disconnected cell site **119** is coupled to antenna **122** using a wired medium **121**. Disconnected cell site **119** is capable of transceiving signals **123, 124** with a plurality of wireless personal communication devices **125, 126** and is capable of communicating signals **123, 124**.

Figure 2 illustrates an exemplary remote, self-contained communications antenna unit **116** that includes a generator **201**, backup batteries **202**, transceiving equipment **203**, a digital signal processor (DSX) **204**, a network interface unit (NIU) **117**, an air conditioner **205**, and an extendable mast **114** that supports microwave antenna **112** and radio frequency antenna **115**. The remote, self-contained communications antenna unit **116** is easily assembled, housed, and transported on a light trailer. Additionally, components **117, 201-204** are configured in a flexible manner such as by mounting them in racks that allows each component to be easily removed and replaced with minimal time and labor resources.

The remote, self-contained communications antenna unit coupled with a disconnected cell site **129** has the appearance of an "on the air" cell site and provides the means to establish wireless communications between the communications network and wireless personal communication devices **125, 126**. In an illustrative embodiment, the remote, self-contained communications antenna unit **116** functions as follows. When cell site **119** is disconnected and goes "off the air" (e.g., the T1 connection is cut), a remote, self-contained communications antenna unit **116** is mobilized. The remote, self-contained communications antenna unit **116** is positioned near or at the disconnected cell site **119** to re-establish communications with the communications network. The trailer that transports the remote, self-contained communications antenna unit **116** is small enough to be placed near the disconnected cell site **119** and the extendable mast **114** supporting microwave antenna **112** and radio frequency antenna **115** is raised. A wired medium **118** is used to connect the CSU **120** to the NIU **117**.



NIU 117 is connected to microwave radio 203, and a signal is transmitted up mast 114 to the microwave antenna 112. The microwave antenna 112 transmits the signal to a nearby cellular system, such as another remote, self-contained communications antenna unit 109 coupled to a "on the air" cell site 101. Alternatively, remote, self-contained
5 communications antenna unit 109 could be coupled using a wired medium to a local service provider's crossbox junction point. Mast 110 is raised along with a matching microwave antenna 111. The two microwave antennas 111, 112 are aligned using extendible masts 110, 114 and signals 123, 124 from wireless personal communication devices 125, 126 are immediately and conveniently communicated to the communications
10 network.

Further details on these embodiments, other possible embodiments, and additional methods and systems of the this invention are set forth below.

The wired mediums discussed above may be a fiber, cable, or other carrier medium.

15 In alternate embodiments, this invention can be mounted on a variety of conventional and non-conventional transportation vehicles, such as, for example, motorized vehicles (e.g., a car, a boat, an airplane, or a helicopter) and non-motorized vehicles (e.g., a utility trailer or a hot-air balloon).

The equipment and communication methods of the remote, self-contained
20 communications antenna unit are usable with all wireless communication products, methods, and frequencies. They are usable with cellular/PCS phones, wireless computers and modems, wireless personal data assistants, global positioning devices, and any other wireless data, voice, or video communications devices. They are usable with satellite phones and satellite communications technology. They are usable with code-division
25 multiple access (CDMA) technologies, time-division multiple access (TDMA) technologies, the global system for mobile communications (GSM) technology, and other technologies. Further, they are usable with all frequencies in the electromagnetic spectrum and are compatible with the June 2000 World Radiocommunication Conference agreement on third-generation cellular telephony.

Additionally, range of operation of the remote, self-contained communications antenna unit is partially a function of transmitter power, and is, therefore, a matter of choice. Antenna selection and siting is also a matter of choice. For example, omnidirectional or directional antennas can be used. Additionally, the remote, self-contained communications antenna unit may include diversity reception of mobile signals in various embodiments of the this invention. Further, linking frequency signal 113 may be in the microwave or other communications band and is the medium over which the remote, self-contained communications antenna unit site communicates with communicates with a cellular system connected to the communications network.

In other various embodiments, the remote, self-contained communications antenna unit includes other useful components. For example, the trailer used to transport the remote, self-contained communications antenna unit includes stabilizing equipment, such as a scissors jack to provide improved trailer stability. Another example is that the mast of the remote, self-contained communications antenna unit may be a telescopic mast that quickly and easily allows the mast to be extended and collapsed.

Various embodiments of the invention have been described in fulfillment of the various objects of the invention. It should be recognized that these embodiments are merely illustrative of the principles of this invention. Numerous modifications and adaptations thereof will be readily apparent to those skilled in the art without departing from the spirit and scope of this invention.